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Evaluating written ergonomic material among sheet metal workers

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EVALUATING WRITTEN ERGONOMIC MATERIAL

AMONG SHEET METAL WORKERS

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ABSTRACT

EVALUATING WRITTEN ERGONOMIC MATERIAL AMONG SHEET METAL WORKERS

By Kristine Lu Whigam Schultz

The purpose of the study is to evaluate the effectiveness of a brochure about ergonomics and sheet metal work to determine if it aids sheet metal workers in their awareness and knowledge on the causes, symptoms, and prevention of work-related musculoskeletal disorders (WMSDs). A true post-only between-subjects experimental design was used to test the hypotheses that sheet metal workers who read written ergonomics educational material will have greater (a) awareness of their susceptibility to, the symptoms of, and preventative actions for WMSDs; and (b) knowledge about the causes, symptoms, and prevention of WMSDs than will sheet metal workers who do not read the brochure. Overall, the findings did not support the hypotheses because the measurements were not reliable enough to detect sheet metal workers having greater awareness or greater knowledge of their susceptibility to, symptoms of, and preventative actions for WMSDs after reading the ergonomics educational material.

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I also thank my employer, Cal/OSHA, for their support and interest in the topic of my thesis. My hope is that this study can make a difference in the publications produced so that the message is clear to employers and employees on how to eliminate or minimize work-related musculoskeletal disorders.

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Chapter 1

INTRODUCTION

Work-related musculoskeletal disorders (WMSDs) are the most common, non-fatal illness and injury among sheet metal workers. WMSDs are a group of painful disorders of muscles, tendons, and nerves caused by work activities which are frequent and repetitive, or activities with awkward postures (Canada's National Occupational Health & Safety Resource [Canada], 1999). These disorders are classified as an "illness due to repeated trauma" and an "illness to the muscles, ligaments, tendons, bones, or nerves that develops over a period of time" (Bureau of Labor Statistics [BLS], 2003, n.p.). According to Schneider (2001), a leading construction ergonomics expert, sheet metal workers' most frequent type of injury occurs due to overexertion, which accounts for 28% of the total non-fatal injuries. In an unpublished study by Welch (2003), she found that 75% of the sheet metal workers, who retired on disability, also had a musculoskeletal disorder. The purpose of this study is to evaluate the effectiveness of a brochure about ergonomics and sheet metal work to determine if it aids sheet metal workers in increasing their awareness and knowledge about the causes, symptoms, and prevention of work-related musculoskeletal disorders. Employers are under ethical obligation and legal and financial accountability to their employees to provide a safe work environment. In addition, government safety and health-related agencies are responsible to educate employers on how to make their work environments safer (Office of Management and Budget &

Executive Office of the President of the United States [OMB], 1993). A challenge from the information reported by the National Occupational Research Agenda [NORA], Musculoskeletal Disorders Team (2001) identifies research needs on work-related musculoskeletal disorders. Their report specifically indicated that evaluation is needed on safety training and/or to evaluate training material, including the dissemination of information about ergonomics.

Furthermore, the Center to Protect Workers' Rights [CPWR] (2002) published statistical summaries in the 2002 *Construction Chart Book* indicating that work-related musculoskeletal disorders are the most common type of non-fatal injuries (e.g., strains and sprains, back pain, carpal tunnel syndrome, soreness and pain other than back) in construction. In particular, employees in the construction trade of sheet metal commonly experience work-related musculoskeletal disorders to the back from overexertion when lifting (CPWR, 2002); problems to the shoulder and neck from hanging duct, and carpal tunnel syndrome in the wrists and hands from using hand tools (Welch, Hunting, & Kellogg, 1995).

Schneider (2001) found that construction contractors were not in agreement with construction work being related to occupational musculoskeletal disorders. In addition, Schneider found that there are a limited number of studies to date on the evidence of work-related musculoskeletal disorders in construction. After Schneider reviewed work-related historical evidence, and data on workers' compensation, medical exams, surveys, and exposures of injuries in construction, Schneider concluded that it would be difficult to deny the existence of work-related musculo-skeletal disorders related to the type of work construction workers perform. Additionally, the Bureau of Labor Statistics reported that construction workers have the second highest number of strain and sprain injuries in the United States (BLS, 2002).

In fact, work-related musculoskeletal disorders (e.g., strains and sprains, overexertion, lifting related, and back injuries) totaled 90.5% of the lost-workday injury data (BLS, 1998) for those working in construction in the United States. Moreover, the rate is based on estimates by the U.S. Bureau of Labor Statistics cited in Weeks and McVittie (1995), and is likely an underestimate since it is based on data only from employers with more than 10 employees. Additionally, Weeks and McVittie (1995) summarized United States Census data that shows 82% of construction contractors employ fewer than 10 employees.

In addition to the number of work-related musculoskeletal disorders in construction, the Center to Protect Worker's Rights [CPWR] (2002) cited Liberty Mutual, a leading worker's compensation insurance carrier, that direct expenses associated to repetitive motion and overexertion activities cost $13 billion in 1999.

Purpose of Study

The purpose of this study is to evaluate the effectiveness of the written content in a brochure on ergonomics for sheet metal workers to determine if it aids them in increasing their awareness and knowledge on the causes, symptoms, work practices, and prevention of work-related musculoskeletal disorders. In addition, Cal/OSHA's

Consultation, Research and Education Unit will utilize the information gained from this study as a basis for the development and evaluation of other written educational material in industries such as food processing, janitorial services, agriculture, and manufacturing.

Problem Statement

This study will determine if written ergonomics educational material in the form of a brochure is effective communication to sheet metal workers for increasing their awareness and knowledge about the prevention of work-related musculoskeletal disorders in their industry.

Hypotheses

The following hypotheses will be tested in this study:

1. Sheet metal workers who read written ergonomics educational material related to their industry of work in the form of a brochure will have greater awareness of their susceptibility to, the symptoms of, and preventative actions for work-related musculoskeletal disorders than will sheet metal workers who do not read the brochure.
2. Sheet metal workers who read written ergonomics educational material related to their industry of work in the form of a brochure will have greater knowledge about the causes, symptoms, and prevention of work-related musculoskeletal disorders than will sheet metal workers who do not read the brochure.

Significance of the Study

Work-related musculoskeletal disorders are the most common and most costly non-fatal illness and injury to sheet metal workers (CPWR, 2002). Only three sources of written ergonomic educational material for sheet metal workers were found. The first is in an interactive Compact Disk-Read Only Memory (CD-ROM) that is only available to sheet metal union contractors and apprenticeship schools as an elective resource to their safety training (Sheet Metal Occupational Health Institute Trust [SMOHIT], 2001). The second is a two-page fact sheet titled *Sheet Metal Ergonomics* offered to employers who are members of the St. Paul Fire and Marine Insurance Company (St. Paul Fire and Marine Insurance Company, 2002). Third, a brochure about ergonomics specific to sheet metal work was published and is free to anyone. It is this brochure, *Ergonomic Survival Guide for Sheet Metal Workers,* published by Cal/OSHA Consultation, Research and Education Unit (2003) that will be the written material read by sheet metal workers to determine if the information in the brochure increases their awareness and knowledge on ergonomic principles and work-related musculoskeletal disorders. Therefore, the results of this study are intended to provide a basis for continual improvement of written ergonomic material.

This author believes that by evaluating the written ergonomic material for sheet metal workers, it will provide an opportunity to improve the development of future material and establish the prerequisite necessary toward the prevention of work-related musculoskeletal disorders among sheet metal workers.

Assumptions

Since there is limited written educational material about ergonomics for sheet metal workers, it is assumed that the sheet metal workers in this study will have equal knowledge and awareness levels about ergonomics in relation to the kind of work they do. It is assumed that by using random assignment, the sheet metal workers who receive the intervention and control brochures will have equal preexisting levels of knowledge and awareness about the symptoms of work-related musculoskeletal disorders and the work practices they can do to reduce developing a work-related musculoskeletal disorder.

Definition of Terms

While certain vocabulary constructs are clear, there are descriptions and words that need to be defined as they are used in this study specific to ergonomics. The following list of words and definitions will be used throughout this study:

Brochure. A brochure is a pamphlet or booklet containing a written, graphic, or photo message with the intent of arousing interest and providing information (Riggs, 2002).

Effective ergonomics. Effective ergonomics is having an intended or expected result that produces a strong, positive impression or response about ergonomics (American Heritage Dictionary, 2000).

Ergonomics. Ergonomics is the application of scientific information concerning humans to the design of objects (e.g., tools), systems (e.g., job process), and the environment (e.g., indoor or outdoor) for human use (Ergonomics Society, 1996). It is fitting the task (i.e., work or job) to the worker (i.e., human) (Kroemer & Grandjean, 1997).

Ergonomic attitude. Ergonomic attitude is an individual's feeling or emotion about ergonomics (Merriam-Webster Dictionary Online, 2002).

Ergonomic awareness. Ergonomic awareness is a cognizance or conscious recognition about ergonomics. It is expressed as a range of what one can understand (Merriam-Webster Dictionary Online, 2002). For purposes of this study and to measure ergonomic awareness, participants will respond in writing to a questionnaire.

Ergonomic knowledge. Ergonomic knowledge is what has been perceived, learned, or discovered about ergonomics (American Heritage Dictionary, 2000). For purposes of this study and to measure knowledge, participants will respond in writing to a questionnaire.

Ergonomic learning. Ergonomic learning is the act, process, or experience of gaining knowledge about ergonomics (American Heritage Dictionary, 2000).

Occupational injury. An occupational injury is a result of a cut, fracture, sprain, or amputation caused from a work-related event (BLS, 2003).

Occupational illness. An occupational illness is an abnormal condition or disorder caused by exposure to factors associated with employment. It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, repeated trauma, or direct contact (BLS, 2003).

Overexertion. Overexertion is described as a level of physical exertion that would exceed a person's capacity to perform the activity resulting in injury (Putz-Anderson,1988).

Prevention. Prevention keeps something from happening (American Heritage Dictionary, 2000), such as musculoskeletal disorders.

Sheet metal worker. A sheet metal worker is a worker in an occupation where workers make, install, and maintain air-conditioning, heating, ventilation, and pollution control duct systems; siding; rain gutters; downspouts; skylights; restaurant equipment; and outdoor signs (BLS, 2002).

Work-related musculoskeletal disorders (WMSDs). WMSDs are a group of painful disorders of muscles, tendons, and nerves caused by work activities which are frequent and repetitive, or activities with awkward postures (Canada, 1999). These disorders are classified as an "illness due to repeated trauma" (BLS, 2003, n.p.). It is an illness to the muscles, ligaments, tendons, bones, or nerves that develops over a period of time (BLS, 2003).

Organization of Project

The first chapter outlines the prevalence of work-related musculoskeletal disorders among sheet metal workers and discusses an approach to evaluate written ergonomic material. It includes the purpose of the study, problem statement, hypotheses, significance of the study, assumptions, and definition of terms.

Chapter 2 contains a review of the related literature. It addresses background information and regulations concerning general safety and health laws, ergonomic laws, and communication requirements for the construction industry. Since limited studies were found specific to the evaluation of written safety, health, and ergonomic material, the framework for this study highlighted techniques and findings from the patient education literature.

Chapter 3 discusses the methodology employed for this study. This chapter will describe the details of the study, including identification and description of the sampling method, human subject consent, research design, procedures and data collection, and overview of the method of quantitative analysis. Results from this study will be presented in Chapter 4.

Chapter 5 will interpret the findings and place them in a context of the hypothesis and the literature review, and analyze the significance and shortcomings of the study. In addition, recommendations will be included for future written material developed by the Cal/OSHA Consultation, Research and Education Unit. Finally, the thesis will conclude with a list of References and five Appendices.

Summary

The purpose of this chapter has been to introduce the reader to ergonomics, work-related musculoskeletal disorders, and written ergonomic educational material for sheet metal workers. In addition, the intent and projected outcome of the study is discussed. Augmenting sheet metal workers' ergonomic awareness and ergonomic knowledge alone does not indicate that work-related musculoskeletal disorders will cease; however, it is a prerequisite and foundation toward the ultimate prevention of work-related musculoskeletal disorders (Dollahite, Thompson, & McNew, 1996). Overall, it is imperative that employers and employees understand the principles of ergonomics, which includes the causes, symptoms, and prevention of work-related musculoskeletal disorders in order for this debilitating illness and injury to cease.

While the exact relationship between exposures and work-related musculo-skeletal disorders is complex, the existing data does show sheet metal workers to be at a significant risk of musculoskeletal disorders. Since sheet metal workers have some control over how they work, such as tool selection and lifting technique, additional attention needs to be on ergonomic education. When sheet metal workers are aware and have knowledge about their work activities that lead to work-related musculoskeletal disorders, then it commences the first step toward the prevention of these disorders.

Chapter 2

LITERATURE REVIEW

Introduction

Although there is a wealth of research and information on communication (Petersen, 1997), and effectiveness of occupational safety training (Johnson, Cattledge, & Collins, 1994), no studies were found in the literature review specific to effective written ergonomic material between a supervisor and employee.

The focus of this chapter is to review studies that evaluate short, written educational material such as leaflets, brochures, and short booklets, as well as how this material is utilized in construction. An emphasis is placed on regulation because it requires safety training; however, the primary goal is to review the literature that discusses the need for effective written material.

An Overview

A study by Petersen (1972) examined how employees view attempts at communicating a safety message. It is generally accepted by employers that when a supervisor or safety personnel trains an employee in safety, health, and ergonomics, the employee effectively learns. Problems can be seen when on-the-job accident records reveal that employees who are "trained" on certain safety, health, or ergonomics topics do not show a decrease in the number of injuries reported to the companies' workers compensation carrier. For example, Snook, Campanelli, and Hart (1978) conducted a study where they found that employees, who were trained on safe lifting techniques to avoid back injuries, did not show a reduced effect on the number of reported back claims.

There are books, pre-written topic sheets, websites, and hundreds of other resources of information on safety, health, and ergonomic training topics; however, only three studies were found in the literature review that attempted to evaluate the effectiveness of written occupational safety and health material. The first study evaluated knowledge of workers after a 1-hour training on lead exposure toxicology and health risks (Porru et al., 1993). The second study evaluated a summer educational campaign to encourage less sun exposure (Borland, Hocking, Godkin, Gibbs, & Hill, 1991). The third study evaluated a month-long education program that encouraged hearing protection devices among firefighters (Ewigman, Kivlahan, Hosokawa, & Horman, 1990). None of these studies could specifically conclude the effectiveness of written educational material. The literature search was expanded due to the lack of specific information on studies in occupational health and safety evaluating awareness and knowledge of written material.

Numerous studies were found outside of ergonomics and occupational health and safety. Studies conducted in patient education literature reviewed brochures, leaflets, booklets, and other educational material. In studies that evaluated written material effectiveness, Calabro, Wendell, and Kapadia (1996); Dannon, Iancu, and Grunhaus (2002); Murphy, Chesson, Walker, Arnold, and Chesson (2000); and Young and Witter, (1994) ascertained that the written material was effective when read.

However, the study by Dannon et al. could not specify what it was about the written material that showed improvements because they did not ask the participants if the brochure was helpful. According to a study by Deijen and Kornaat (1997), it was found that brochures did aid in improved knowledge of how to handle missed contraceptive pills. They concluded that brochures were read more than audiotapes were listened to. Another study by a Dutch medical group, Kruse et al. (2000), found that brochures and booklets improved participants' knowledge significantly with a mean score of 71% compared to the control group. And contrary to the content, Frost, Thompson, and Thiemann (1999) and Jamison (2000) discovered that patients prefer brochures that have nice colors (e.g., blue, green, and yellow), 12-point font size, bold headings, pictures, and information listed in bullets.

For approximately the last 30 years, the typical style of safety training for construction workers has been through a "tailgate" or "toolbox" meeting as described by Varley and Boldt (2002a) who have been conducting research to evaluate the effectiveness of written training material for sand and gravel miners. Tailgate or toolbox meetings are usually 5- to 20-minute safety meetings held daily, weekly, or every 10 days at the beginning of a workday. Examples of the safety topics may include safe lifting techniques, machine guarding, or proper use of ladders. Another report by Varley and Boldt (2002b) suggests that the written safety material used in tailgate/toolbox training has not been sufficiently evaluated. This information is supported by the fact that there is little to no published literature where written occupational safety, health, and ergonomics material has been evaluated on awareness, knowledge, attitude changes, and preference style. Petersen (1997) sums it up by saying that safety posters, safety films, safety literature, and 5-minute safety talks are all a big part of occupational safety, but most of it has never been tested on effectiveness. If an employer's program is successful (reduced injuries) or fails (increased injuries), there is no way of knowing which component of the employers' safety program or safety material made it effective, or not (Petersen, 1997).

Background

In December 1970, President Nixon signed a law known as the Williams-Steiger Occupational Safety and Health Act (Pierce, 1996). This law created four bodies: the Occupational Safety and Health Administration (OSHA), the National Institute of Occupational Safety and Health (NIOSH), the Occupational Safety and Health Review Commission, and an advisory committee for safety and health. OSHA was established to enforce the OSH Act. During the passage of this act, businesses, workers, unions, and safety and health professionals were ambivalent about regulations. Essentially, businesses wanted fewer regulations while workers, unions, and health and safety personnel wanted regulations that offer more protection and accountability to protect the workers from illnesses and injuries (Pierce, 1996).

In 1973, California established its own state OSHA program, California OSHA [Cal/OSHA] (California Department of Industrial Relations [DIR], 2002). The Cal/OSHA program had to enact similar regulations that were at least as stringent as the federal standards and cooperate in reporting to federal OSHA (Pierce, 1996). In 1993, Assembly Bill 110 added Section 6357 to the Labor Code, requiring that the Cal/OSHA Standards Board adopt an ergonomics standard (DIR, 1993). Four years later, on July 3, 1997, 8 California Code of Regulations (CCR), Section 5110, Repetitive Motions Injuries (RMIs), became enforceable by law in California (California Division of Occupational Safety and Health [Cal-DOSH], 1999). This became the first ergonomics standard established in the United States.

Summarized, the Ergonomics Standard applies to a job, process, or operation where a repetitive motion injury has occurred to more than one employee under four conditions (CCR, 1997). First, the employees' injuries must be predominately related to the kind of work they are doing; second, the employees must be doing identical work activities; third, a licensed physician must diagnose the repetitive motion injuries are musculoskeletal; and fourth, the repetitive motion injuries must be reported within a 12-month time period. If all four of these conditions occur, then the employer must design a program to minimize the repetitive motion injuries. The program shall include a worksite evaluation, a way to control or improve the problems causing the repetitive motion injuries, and employee training (CCR, 1997). For a detailed description of the Ergonomics Standard, refer to Appendix A.

The written communication tool (brochure) being evaluated in this study is designed to assist the employer (e.g., construction foreman) with requirements of the ergonomics standard, such as training workers about the exposures, symptoms, and consequences associated with Repetitive Motion Injuries.

In addition to the Cal/OSHA regulations, Cal/OSHA is accountable for the educational material they produce (Legislative Council of California, 1973). This includes, according to California Labor Code, Section 6300, providing research, information, education, and training in the field of occupational safety and health.

Moreover, in 1993, the U.S. Senate and House of Representatives enacted the Government Performance and Results Act as published by the Office of Management and Budget, Executive Office of the President of the United States [OMB] (1993). The purpose of this federal act was to provide the establishment of strategic planning performance measurement in the federal government and improve accountability of federal programs to those living in the United States. This act states that federally-funded programs need to initiate program performance by setting goals; measuring their goals; and improving their program effectiveness and public accountability, service quality, and public satisfaction (OMB, 1993). Both the National Institute for Occupational Safety and Health (NIOSH) and Occupational Safety and Health Administration (OSHA) were charged with delivering occupational safety and health training (Loos & Fowler, 1999).

According to Loos and Fowler (1999), in order for NIOSH to meet the requirements of the Government Performance and Results Act, NIOSH developed the Training Intervention Effectiveness Research (TIER) model. This model was developed as an effort to provide researchers with an approach to identify the elements of training that are critical to increased effectiveness in training and safety education. The Department of Industrial Relations (DIR), California Occupational Safety Health

Administration (Cal/OSHA), Consultation, Research and Education Unit receives funding through federal OSHA. Therefore, the program director must annually report in writing to federal OSHA about the educational material being developed and the number of requests for such publications. To ensure that the written safety, health, and ergonomic material is effective for employers and employees in California, further evaluation is needed.

The Cal/OSHA Consultation, Research and Education Unit is interested in measuring the effectiveness of their publications to assist employers and employees in preventing work-related injuries and illnesses. This will enhance the written occupational safety, health, and ergonomics material published, and complies with the Government Performance and Results Act.

Use of Written Material

Riggs (2002) pointed out that general, global terms for brochures are defined as collateral pieces that can stand alone. The idea is that the message should be abbreviated with the intent to arouse interest. A brochure is technically a piece of printed material, folded to a convenient size, with each panel section as something that explains a single message or is part of a continuing message (Riggs, 2002).

The studies discussed below are from journals in occupational safety and health, health education, and patient education.

Occupational Safety and Health

Few studies have been done that evaluate the effectiveness of written health, safety, and ergonomics material. However, four studies were found that attempted to evaluate written material as part of an effective training intervention. Porru et al. (1993) conducted a study with 50 workers at seven factories where there was significant lead exposure. The study took place over a 1-year period and was broken into three phases. The first phase included plant inspections to evaluate lead exposure risks, blood samples to measure lead levels, and a questionnaire. In addition, an occupational physician taught a 1-hour training class about the transfer of lead toxicology, lead health risks, and how to reduce lead exposure to work practices. Workers were also given a booklet that illustrated the topics. All but the 1-hour training class and booklet were repeated in phases two and three. The findings over a 1-year period showed an 80% reduction in lead blood levels and 74% of workers had improved scores on the questionnaire. The authors concluded that the positive results occurred because of the training. However, the authors did not specifically evaluate if the written material (booklet) increased their awareness or knowledge. In addition, Porru et al. did not observe for any behavior changes.

A study by Borland et al. (1991) was done at a telephone company in Australia. They conducted a summer educational campaign in six of their districts where sun exposure was a problem. The campaign encouraged staff to cover up, such as with a hat, to avoid skin cancer. For 4 months, weekly poster displays were set up, video segments with information about the campaign were shown, and buttons and brochures were distributed about the harm of skin cancer from the sun. They found from their pre and post campaign comparisons that only 2% of the employees changed their behavior to wearing hats. However, they did note a 65% increase in staff wearing upper body attire and attempting to work in the shade. Unfortunately, Borland et al. did not evaluate what specifically aided in the campaign. They could not indicate if it was the video segments, brochures, buttons, or weekly posters.

Another occupational health and safety related study was done by Ewigman et al. (1990). They focused on increasing firefighters' knowledge of noise hazards through training and the use of protective devices. A city had found that 94 of their active duty firefighters had an increase in hearing loss, suggesting that there was a need for a hearing education and conservation program. An intervention group received a month-long education program that included handouts, videotapes, lectures, and interviews. In addition, each person was given three different types of hearing protection devices. A questionnaire was mailed out 1 month before the education program and 1 month after the education program. In comparison of the two questionnaires, a 25% increase in knowledge was found and there was a 65% increase in use of hearing protection devices. From this Ewigman et al. (1990) study, it is unknown which part, if any, of the educational intervention was the most effective (i.e., handouts, videotapes, lectures, or interviews).

In 2000, researchers Marino and Cohen, from the Safety and Health Assessment and Research for Prevention Program (SHARP) at the Washington State Department of Labor and Industries, administered a hand care survey to 93 hospital infection control personnel representing 106 hospitals in Washington (Marino & Cohen, 2001a). Their survey was used to determine the characterization of the moisturizers, hand-washing agents, alcohol gels, and gloves used in Washington hospitals and to assess the awareness of compatibility issues associated with certain hand-washing agents, gloves, and moisturizers (Marino & Cohen, 2001b). In response to the hand care survey, Marino and Cohen (2001b) created an educational booklet entitled *Prevention of Hand Dermatitis in the Heath Care Setting* and mailed the booklet to the same recipients to assist them in preventing hand dermatitis in the health care setting. As a follow-up to the dissemination of the booklet, SHARP researchers Curwick, Bonauto, and Cohen (2002) sent a cover letter and a 1-page survey consisting of nine questions to 590 of the hospital worker participants to determine whether they had received the booklet, *Prevention of Hand Dermatitis in the Heath Care Setting,* and if they found the booklet to be a valuable tool for health care personnel. They also asked for their opinion about optimal length and method of dissemination of information materials on workplace safety and health.

Of the 590 surveys submitted, 158 were returned completed, which resulted in a response rate of 27%. All the respondents indicated that the booklet was clearly written and easily understood, 73% felt written informational material should be limited to one to two pages, and 99% believed that the booklet provided practical tips for preventing hand dermatitis in the health care setting. It was concluded by Curwick et al. (2002) that the respondents' awareness to the information in the booklet may or may not have resulted from reading the booklet. Respondents may have had pre-existing knowledge of the issues or sought out more information from other sources.

Health and Patient Education

Literature was found and reviewed on the effectiveness of health education materials of brochures, leaflets, and written health education material. This comes predominately from the studies of written patient education material. According to Doak, Doak, and Root (1996), one reason why written patient education material is being studied more heavily derives from the directives given to health care providers by the Joint Commission on Accreditation of Health Organizations (JCAHO), which states that health care providers must verify that patients understand their instructions. Journal articles from the patient education literature addressed the role of brochures and written material. The studies selected were divided as follows: (a) effectiveness (Calabro et al., 1996; Dannon et al., 2002; Murphy et al. 2000; and (b) knowledge, attitude, and compliance (Deijen & Kornaat, 1997; Kruse et al., 2000).

Three studies selected strove to measure the effectiveness of written education material. In the first study, Calabro et al. (1996) did a comparison to determine if materials were more effective when written at the third grade level or the tenth grade level. They evaluated 252 women, 15 years or older, at a public health maternity clinic. The intent of their study was to determine the women's self-reported use of alcohol and changes in knowledge, attitude, and behavioral intention to avoid alcohol after reading the written material. Descriptive statistics were calculated and mean pre and post responses were compared using a paired *t*-test. The written material that showed the greatest changes in knowledge, attitude, and behavioral intention were considered most effective. The results of Calabro et al. showed that English-speaking participants who read the material at the third grade level recalled more information and showed greater changes in knowledge, attitude, and behavior intentions than those who read written material at the tenth grade level.

In the second study, Murphy et al. (2000) did a comparison to determine if viewing a videotape was more effective at increasing short-term knowledge about sleep apnea than reading a simplified brochure written at the twelfth grade reading level. A structured questionnaire with 11 comprehensive questions (i.e., three open-ended, and eight multiple-choice) about sleep apnea was given to 192 participants immediately after viewing the videotape or reading the brochure. The participants were asked to define sleep apnea, name three symptoms of sleep apnea, and select a multiple-choice answer from the questions about sleep apnea. To measure effectiveness, chi-square tests were used to estimate the differences between literacy and comprehension questions. The results of Murphy et al. demonstrated that the written material was at too high a reading level for 40% of the participants. Also, the participants with a twelfth grade education level actually had an eighth to ninth grade reading level.

In the third study, Dannon et al. (2002) randomly selected 84 patients at an outpatient clinic who were being treated for panic disorders and who were prescribed the drug Paroxetine. A masked rater did a follow up at 1-week, 3-weeks, and 12-weeks to determine if the Paroxetine and the brochure (Group A) had a beneficial effect over those receiving Paroxetine without the brochure (Group B). After 3 weeks, an improvement of less anxiety was seen from Group A. After 12 weeks, the ratings between the two groups were equal. Dannon et al. concluded that it is important to give the educational material (brochure) early in the treatment process.

The next category of studies looked at participants' attitude, knowledge, and compliance after reading written educational material. Deijen and Kornaat (1997) conducted a before and after study with 1,239 women between the ages of 15 and 49 to determine if the women had improved attitude, knowledge, and compliance after receiving brochures and information on audiotape about oral contraceptives. Overall, they found that knowledge of the medical advantages of the pill increased use of the pill after listening to the audiotape, and the compliance of using the pill increased after reading the brochure and listening to the audiotape. The participants who only read the brochure did improve their knowledge of how to handle missed pills.

A Dutch group, Kruse et al. (2000), conducted a study among outpatients' knowledge and attitude toward written information. They randomly tested 415 outpatients in three groups; a control group and the other groups were given a leaflet, brochure, or booklet. Prior to the issuance of the written material and 2 weeks post intervention, participants were given a multiple choice and Likert scale questionnaire to measure their attitude and knowledge. Kruse et al. found that the patients' knowledge improved significantly ($p < 0.001$ and $p = 0.007$) from the brochure compared to the control group.

In conclusion, the studies on the written material in occupational health and safety needs additional evaluation, specifically on the written material separate from the overall training. This is important for two reasons. First, it can ensure that the written material is understood by workers and, second, it provides injury prevention information in situations where verbal communication may not be possible. This would also assist construction employers as they strive to comply with Cal/OSHA regulations in their toolbox/tailgate meetings.

Toolbox/Tailgate Safety Training

The terms "toolbox" and "tailgate" safety training are used interchangeably throughout the literature. Safety in working with equipment and awareness of potential accidents or hazards are ongoing issues in construction. Safe work practices must be taught and followed to prevent worker injury. Due to the high number of injuries and illnesses, additional Cal/OSHA regulations are placed on construction employers to establish, implement, and maintain an effective safety program (Paul, Hastings, Janofsky, & Walker, 1992).

Specifically, California's Occupational Safety and Health Administration [Cal/OSHA] requires that each construction employer have an effective Injury and Illness Prevention Program (IIPP) in accordance with Section 8406 and 1509 of the California Code of Regulations (CCR). A complete description of Title 8, Section 1509 of the CCR for the construction industry is listed in Appendix B.

According to Varley and Boldt (2002), toolbox safety training has often been described as short, informal meetings at a worksite often led by the foreman, supervisor, safety coordinator or other competent person. Varley and Boldt explain it as a form of getting workers together to talk about changes in the workplace rules, conditions, or hazards. This is done by sharing the topics with the work group and discussing with them how changes will affect the way the workers perform their jobs. It is an opportunity to exchange information and to share experiences and knowledge.

A fact sheet by the California Division of Occupational Safety and Health (Cal-DOSH, 2001), California Department of Industrial Relations (DIR), entitled *Setting up a Tailgate/Toolbox Safety Meeting,* describes the meetings as 10 to 15 minute on-the-job meetings held to keep the employees alert to work-related accidents and illnesses. The fact sheet also describes the reasons for the meeting, what to talk about, and how to conduct an effective meeting.

The Labor Occupational Health Program [LOHP] (State Building and Construction Trades, 2001) developed a curriculum in a three-ring binder entitled *Tailgate Training for California Construction Workers*. It is available in both Spanish and English and offers 28 tailgate safety meeting documents that encompass information the construction foreman or trainer needs to lead an effective tailgate safety meeting. The LOHP emphasizes that each meeting should be 20 to 30 minutes long and be limited to one topic that relates to the kind of work the crew is doing or will be doing in the near future.

Summary

An emphasis is placed on using the written material as a tool for gaining awareness and knowledge and as a pre-condition to change behavior for safer work practices. While health and patient education studies are more frequent in evaluation of written material, it does not replace the need for studies in occupational safety, health, and ergonomics. More studies are needed that measure the effectiveness of written safety, health, and ergonomics material that measures increased awareness and knowledge after exposure to the material.

Effective written educational material in ergonomics can offer a powerful opportunity of awareness and knowledge to sheet metal workers to prevent musculoskeletal disorders.

The method of this study is described in the following Chapter 3.

Chapter 3

METHOD

This study will seek to determine if written ergonomics educational material in the form of a brochure is effective communication to sheet metal workers for increasing their awareness and knowledge about the prevention of work-related musculoskeletal disorders in their industry. The materials, procedures, and sample used to complete this study are explained below.

Participants

The 14 participants for this study were obtained from the Sacramento Valley Sheet Metal Worker Apprenticeship and Training School. A telephone call to the administrator of the Sacramento Valley Sheet Metal Workers Apprenticeship and Training program was made to request his cooperation with the study. There are 116 sheet metal workers enrolled in the 5-year program in the greater Sacramento, California area and the school is a member of the Sheet Metal Workers Local Union 162. Of the 114 male and two female students recruited at the school, 12% ($n = 14$) participated in the study. The age of the participants who returned the questionnaire ranged from 23 to 45, with a mean age of 31.36 years. In addition, 100% of those who returned the questionnaire were male.

Instrumentation

Brochures

The *Ergonomic Survival Guide for Sheet Metal Workers* brochure was the written educational material evaluated in this study (i.e., the treatment). The

Cal/OSHA Consultation Service, Research and Education Unit created this brochure in 2003 to raise the awareness and knowledge of sheet metal workers about the causes, symptoms, and prevention of musculoskeletal disorders. It is a pocket-size brochure with picture illustrations of ergonomic tips for sheet metal workers. The brochure was also reviewed for technical accuracy to insure that the information related to ergonomics and to the type of work in the sheet metal industry. A copy of the intervention brochure is referred to in Attachment 1 and appears in the pocket.

The control brochure was about air bag safety and was created by the Automotive Coalition for Traffic Safety, Inc. This brochure was used because it did not present ergonomic-related material that the respondents in the control group could use to answer the knowledge questions (i.e., a placebo). Similarly, although the questionnaire was also safety-related in a general sense, it did not present information that would increase the control participants' knowledge and awareness of ergonomics in the sheet metal industry. A copy of the control brochure is referred to in Attachment 2 and appears in the pocket.

Questionnaire

The device (instrument) used to measure ergonomic awareness and knowledge was a 15-item questionnaire created for use in this study. The participants were asked to read the brochure before they completed the questionnaire, and to not refer to it while they were completing the questionnaire. The first 10 items on the questionnaire were used to measure knowledge about ergonomic practices in the sheet metal industry as presented in the brochure. Each item used a multiple-choice format with four possible answer choices. The respondents were asked to circle the best answer choice for each knowledge question based on the content of the brochure. Total knowledge scores were created by grading each question and summing the number of questions correctly answered out of 10 possible. Hence, total knowledge scores can range from zero, indicating no knowledge about ergonomic in sheet metal work, to 10, indicating a high level of knowledge about ergonomics in sheet metal work.

The last five items on the questionnaire were used to measure awareness of ergonomics in sheet metal work. Each item presented a statement related to ergonomic awareness. Participants were asked to indicate the response that best represented how much they agreed with each statement using a 5-point Likert ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). For example, one item asked, "Whenever possible I will use power tools or tools that require less force at work." A higher-numbered response to this item would indicate a greater ergonomic awareness. Three of the items presented statements representing a higher level of ergonomic awareness, while the other two items presented statements of a lower level of ergonomic awareness. Hence, higher ratings for the positively worded items indicate a greater ergonomic awareness, and lower ratings for the negatively worded items indicate a greater ergonomic awareness. Total awareness scores were calculated by summing the participants' responses to all five items, after recoding their responses to the two negatively worded items. Total ergonomic awareness scores could therefore range from 5 to 25, with higher scores indicating a higher level of ergonomic awareness.

The questionnaire also had items for collecting the participants' ages, genders, years of experience in sheet metal work, year in the apprenticeship program, and highest grade of school completed. A copy of the entire 15-item questionnaire is shown in Appendix C.

Pilot Study

The questionnaire was pilot tested among a sample of 10 Cal/OSHA Health and Safety colleagues from Sacramento to ensure that it was readable and adequately covered the content in the brochure (i.e., content validity). Ten participants in the pilot study, five in the control group and five in the intervention group, received the same packet that was sent to the participants in the full study; however, the packet was handed directly to the participants rather than mailed to them. The pilot study was used to confirm the clarity and readability of the questionnaire. Participants in the pilot study gave verbal feedback supporting the ease of the instructions and wording of the questions. Respondents unanimously indicated that the raffle prize to Home Depot was an original and effective incentive.

Procedures

The sheet metal workers for both the intervention and control group were recruited from the Sacramento Valley Sheet Metal Worker Apprenticeship and Training School. The administrator of the Sacramento Valley Sheet Metal Workers

Apprenticeship and Training program at the school was contacted to request his cooperation with the study. The administrator agreed to mail the study materials to the 116 apprenticeship students enrolled in the school. A copy of the letter from the administrator is shown in Appendix D.

All the sheet metal workers at the school were sent a packet of study materials. Each packet consisted of a cover letter explaining the purpose of the study and an invitation for the recipient to participate, along with a stamped return envelope. The letter indicated that a Home Depot gift certificate worth $50 would be given to one respondent whose name was randomly drawn through a raffle as an incentive to participate. The letter explained that respondents were eligible for the raffle, whether or not they actually completed the questionnaire. A raffle ticket was included with each study packet. A copy of the letter and consent form is shown in Appendix E. Each packet also included the 15-item ergonomic awareness and knowledge questionnaire.

Half of the packets (58) included the *Ergonomic Survival Guide for Sheet Metal Workers* brochure (i.e., the intervention brochure), and the other half (58) had the *What You Need to Know About Air Bags* brochure (i.e., the control brochure). Although the overall response rate was 12%, the students were randomly assigned to the study conditions. A random number scheme was used to determine whether they were to receive the intervention or control packet. The questionnaires sent with the intervention brochure were printed on blue-colored paper, while those sent with the control brochure were printed on yellow paper. This was done so the study group for each participant could be determined upon receiving their completed study materials. The completed study packets were mailed to the students in sealed envelopes.

Design

A true post-only between-subjects experimental design will be used to test the hypotheses that sheet metal workers who read written ergonomics educational material related to their industry in the form of a brochure will have greater (a) awareness of their susceptibility to, the symptoms of, and preventative actions for work-related musculoskeletal disorders; and (b) knowledge about the causes, symptoms, and prevention of work-related musculoskeletal disorders than will sheet metal workers who do not read the brochure. The independent variable was the type of material read by the participants, with the following two levels: (a) the *Ergonomic Survival Guide for Sheet Metal Workers* brochure (intervention), and (b) the *What You Need to Know About Air Bags* brochure (control). The first dependent variable was the participants' knowledge of ergonomic work in the sheet metal industry, as measured by the first 10 items on the questionnaire created for use in this study. An example of an ergonomic knowledge question that requires choosing one best answer is, "The most common injuries in sheet metal work affect specific body part(s), such as (a) toes, (b) back, (c) elbows, (d) hips." The second dependent variable was the participants' ergonomic awareness, as measured by the last five items on the study questionnaire. An example of an ergonomic awareness question requiring the participants to choose their agreement with the statement is, "Muscle strain injuries are not very common in my line of work: strongly disagree, disagree, neutral, agree, or strongly agree."

Analysis of Data

The ergonomic knowledge and awareness scores of the intervention and control groups will be compared using two independent-samples *t* tests, one for each dependent variable. Although there are power issues with only 14 participants, this test is the most appropriate to use when comparing the means of two groups and the design of the study is between-subjects in nature. The data will be analyzed using the computer software program, Statistical Package for the Social Sciences (SPSS), version 11.5 (2002). An alpha level of .05 will be used to determine the statistical significance of each independent *t* test. This alpha level indicates that differences between the intervention and control group on awareness and knowledge will be deemed to be statistically significant (i.e., real differences) if their likelihood of occurrence is less than 5 times out of 100 by chance alone. The internal-consistency reliability of the knowledge and awareness items on the study questionnaire will be determined using Cronbach's alpha coefficient. This coefficient can range from 0 to 1.0, with higher values indicating a higher level of uniformity among the items on each subscale.

Chapter 4

RESULTS

To create total knowledge scores, the participants' responses to items 1 through 10 were scored and summed. Total knowledge scores for all participants combined ranged from 6 to 10, with a mean score of 8.79 ($SD = 1.25$). The internal-consistency reliability of the 10 knowledge items was calculated using Cronbach's alpha coefficient. The obtained coefficient of .52 indicated a good level of reliability and consistency among the 10 knowledge items.

Ergonomic awareness attitude scores were created by summing the participants' responses to items 11 through 15, after recoding their responses to items 11 and 13. A higher-numbered response for these items actually indicated a poorer ergonomic attitude while higher total attitude scores indicate better awareness of ergonomics in sheet metal work. To explain, one out of the two negatively-worded awareness questions is a statement that if answered by "strongly disagree" or "disagree" could prevent an injury. For example, item 11 asks, "I will bend forward at the waist to lift material at work." By disagreeing with this answer, the participant states that he does not bend forward at the waist to lift material. If the participant bent forward at the waist to lift material, he could injure his back. The second negatively-worded awareness statement is item 13, "Muscle strain injuries are not very common in my line of work." By disagreeing with this answer the participant is aware that muscle strain injuries are common in his line of work. The positively-worded awareness questions are worded with statements that the participant agrees with or would do. For example, item 12 states, "Whenever possible, I will use power tools or tools that require less force at work." Agreeing to this statement means that the participant is aware that power tools and tools that require less force can prevent an injury.

The mean ergonomic awareness attitude score for all participants combined was 21.79 (*SD* = 2.08). The internal-consistency reliability coefficient of the five ergonomic awareness attitude items was 0.28. Although this coefficient is not high, it is based on only five items and suggests an acceptable level of consistency among the attitude questions.

Exploratory Correlation of Demographic and Dependent Measures

For exploratory purposes and to examine participant homogeneity, a series of Pearson product-moment correlations was calculated among the demographic variables (except gender) and the participants' ergonomic knowledge and attitude scores. An alpha level of .05 was used to determine the statistical significance of each correlation. The results are shown in Table 1.

The only statistically significant correlation was between ergonomic attitudes and highest grade level completed, $r(9) = -.67$, $p < .05$, $r^2 = .45$. Specifically, this correlation indicated that the sheet metal workers who had lower education grade levels (e.g., 12 or 13) tended to have better ergonomic awareness attitudes than did those who had higher education grade levels. Although a number of the other observed correlation coefficients were fairly large in magnitude, the small sample size of the study did not provide enough power to find them to be statistically significant. Even after acknowledging the low statistical power, it does not appear to be the case that ergonomic knowledge and awareness attitudes are related to each other. Although the correlation between years of sheet metal experience and ergonomic awareness was technically not statistically significant, the results did suggest a trend (p = .077) that those who had more years of experience tended to have better ergonomic awareness than did sheet metal workers with fewer years of experience.

Table 1

Exploratory Correlations Among Demographic Variables, Ergonomic Knowledge Scores, and Ergonomic Awareness Attitude Scores

Variable	1	2	3	4	5
Age	--				
Highest grade level	-.20	--			
Years of experience	.25	-.12	--		
Years in program	.20	.14	.47	--	
Ergonomic knowledge	.14	-.23	.15	-.04	--
Ergonomic attitude	.38	-.67*	.49	-.05	.04

Note. Gender was not included in the correlations because 100% of the participants were male.

*p < .05.

Ergonomic Knowledge Comparisons

Recall that it was hypothesized that sheet metal workers who read written ergonomic education material related to their industry in the form of a brochure would have greater knowledge about the causes, symptoms, and prevention of work-related musculoskeletal disorders than would sheet metal workers who did not read the brochure. To test this hypothesis, an independent-samples *t* test was computed comparing the mean knowledge score of the sheet metal workers who received the brochure to that of the sheet metal workers who received the air bag safety (control) brochure. An alpha level of .05 was used to determine the statistical significance of the *t* test. The mean knowledge score of those who received the brochure was 9.13 ($SD = 1.13$) and that for those who received the control brochure was 8.33 ($SD = 1.37$). The means are illustrated in Figure 1.

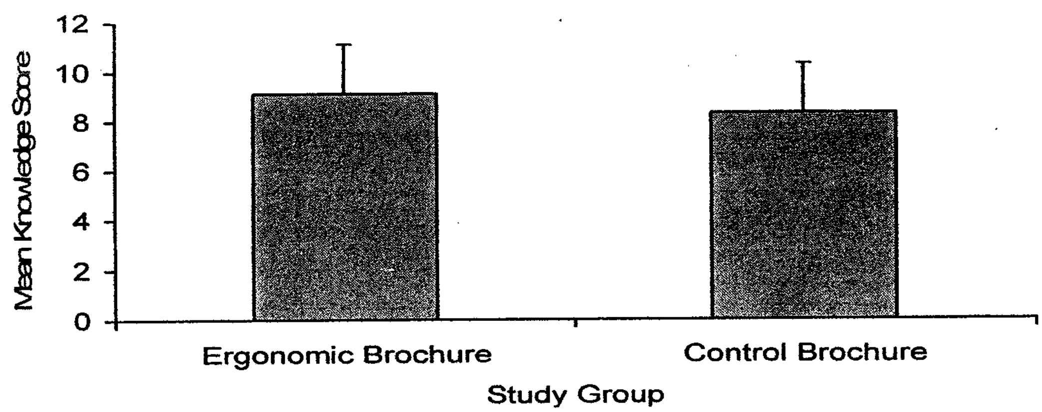

Figure 1. Mean knowledge scores for sheet metal workers who received the ergonomics brochure and those who received the control brochure.

The results of the independent-samples *t* test did not indicate a statistical difference between the mean knowledge scores of the two groups, which does not support the hypothesis that those who received the brochure would have more knowledge about ergonomics in sheet metal working, $t(12) = 1.12, p > .05$. In fact, the high mean scores of the two groups suggest that either the knowledge test was too easy, or they already knew the answers to the questions without needing to read the brochure. Table 2 presents a summary of the answers to the ergonomic knowledge questions.

Ergonomic Awareness Attitude Comparisons

The hypothesis regarding ergonomic attitudes was that sheet metal workers who read the ergonomics brochure related to their industry would have greater awareness of their susceptibility to, the symptoms of, and preventative actions for WMSDs than would sheet metal workers who did not read the brochure. To test this hypothesis, the mean awareness attitude scores of the two groups were compared, again using an independent-samples *t* test and alpha level of .05. A higher mean ergonomic awareness attitude score indicates better awareness of the factors related to WMSDs in sheet metal work. The mean ergonomic awareness attitude score for those who received the brochure was 21.75 ($SD = 2.38$), while the mean score for those who did not receive the brochure was 21.83 ($SD = 1.84$). These ergonomic awareness attitude means are illustrated in Figure 2.

Table 2

Summary of Answers to Ergonomic Knowledge Questions

Knowledge-based Questions	A*	B*	C*	D*
1. What can you lose if you get injured at work and can't work? **Correct Answer: A, your salary**	8 / 6			
2. The most common injuries in sheet metal work affect specific body part(s), such as: **Correct Answer: B, back**		7 / 6	1 / 0	
3. Certain things in your job can lead to fatigue, discomfort, or pain if you do them repeatedly or without breaks. These include (select one best answer). **Correct Answer: B, remaining in the same position for a long time with little or no movement**		7 / 5	0 / 1	
4. What are some ways you can physically prepare for work? **Correct Answer: C, warm up and stretch**			8 / 6	
5. If you have to lift a long, heavy piece of material from the floor by yourself, it is helpful to: **Correct Answer: A, squat; tilt object on end; lift**	7 / 6			1 / 0
6. A 10-pound object that is 25 inches from your spine is equal to what weight of force on your lower back? **Correct Answer: C, 250 lbs.**	2 / 5	1 / 0	5 / 1	
7. If you experience symptoms of injury, you must change the way you work or the tool you use. What are some of the symptoms? **Correct Answer: C, numbness, tingling**			8 / 6	
8. What can help you make your work easier and avoid injury? **Correct Answer: A, changing body positions; alternating work tasks as much as possible**	8 / 6			
9. Keeping your wrist straight by using an angled tool or or repositioning the material will: **Correct Answer: C, give you a better grip strength**	1 / 2	1 / 0	6 / 4	
10. To avoid kneeling while cutting material: **Correct Answer: B, use existing equipment to create a stable "work bench"**	0 / 1	8 / 4		0 / 1

*Numbers on the left represent answers from the 8 participants in the intervention group; numbers on the right represent answers from the 6 participants in the control group. $n = 14$

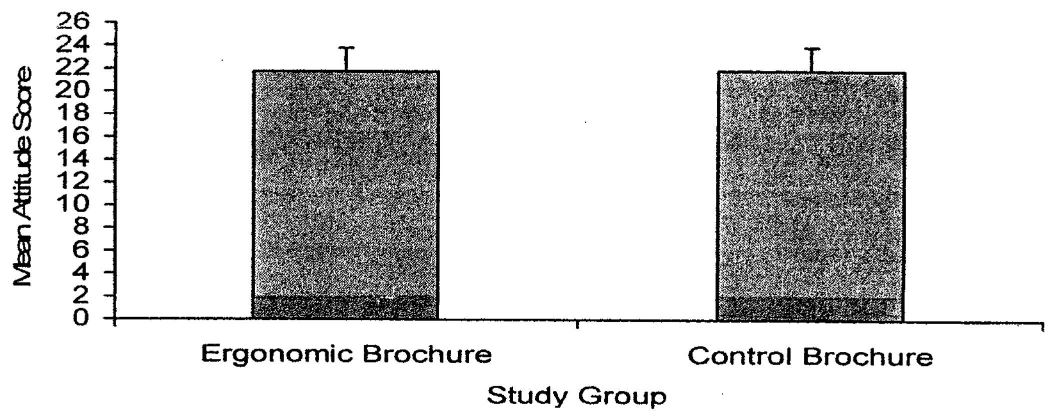

Figure 2. Mean ergonomic awareness attitude scores for sheet metal workers who received the ergonomics brochure and those who received the control brochure.

The results of the independent-samples t test for the ergonomic awareness attitude scores also did not indicate a statistically significant difference between those who received the ergonomics control brochures, $t(12) = -0.07, p > .05$. Indeed, the mean ergonomic awareness attitude scores were almost identical, and the scores for both groups are again very high (approximately 22 out of a possible 25). Table 3 represents a summary of answers to the ergonomic awareness statements.

Table 3

Summary of Answers to Ergonomic Awareness Statements

Awareness-based Statements	Strongly Disagree*	Disagree*	Neutral*	Agree*	Strongly Agree*
11. I will bend forward at the waist to lift material at work.	8 / 5	0 / 1			
12. Whenever possible I will use power tools or tools that require less force at work.				0 / 1	8 / 5
13. Muscle strain injuries are <u>not</u> very common in my line of work.	7 / 3	0 / 3		1 / 0	
14. If I feel weaknesses in my hands while working, I will talk to my supervisor.	1 / 0	1 / 1	2 / 2	2 / 2	2 / 1
15. There are many things that I could do at work to prevent a muscle strain injury.	1 / 0		1 / 0	4 / 5	2 / 1

*Numbers on the left represent answers from the 8 participants in the intervention group and numbers on the right represent answers from the 6 participants in the control group. *n*=14

Chapter 5

DISCUSSION

This study was conducted to evaluate the effectiveness of written ergonomic material for sheet metal workers. The study design consisted of a true post-only between-subjects experimental design to test the hypotheses that sheet metal workers who read written ergonomic educational material related to their industry in the form of a brochure will have greater (a) awareness of their susceptibility to, the symptoms of, and preventative actions for musculoskeletal disorders; and (b) knowledge about the causes, symptoms, and prevention of work-related musculoskeletal disorders than will sheet metal workers who do not read the brochure.

Findings

The findings did not support the hypotheses because the measurements were not reliable enough to detect sheet metal workers having greater awareness or greater knowledge of their susceptibility to, symptoms of, and preventative actions for work-related musculoskeletal disorders after reading the ergonomics educational material. One reason for this may be that the questionnaire was too easy for most of the participants to answer the questions correctly. Another reason may be that the participants already knew the answers because they were previously exposed to the information.

A third reason the findings did not support the hypotheses relates to 116 participants being mailed the questionnaires and a total of 14 returning the completed questionnaires, giving this a 12% response rate. Even though the participants were given a return, self-addressed stamped envelope and offered an opportunity to enter a raffle worth $50 for returning the questionnaire, few participated.

A fourth reason the findings did not support the hypotheses may be that the testing procedures were too cumbersome for this construction worker population. The participants received a packet of information containing the consent forms, two-page questionnaire, and written material to review. It is possible that it may have been too difficult for the participants to read the information or that the participants did not want to take the time to read, respond, and return the material. It is also possible that if the written material were presented in a more natural setting, such as at a safety meeting, then more of the participants would have responded.

Interpretation

It was anticipated that the response rate would be low based on other literature that involved mail-out questionnaires, such as the one reported by Curwick et al. (2002). However, it was a surprise that the response rate was a low of only 12%. And, as disappointing as this is, it also made it impossible to do any kind of meaningful statistical analysis.

Aside from the low response rate and limited statistical power, the answers to two questions are interesting. The first question was #6, an ergonomic knowledge-based question. The question reads, “A 10-pound object that is 25 inches from your spine is equal to what weight of force on your lower back: (a) 50 pounds, (b) 175 pounds, (c) 250 pounds, or (d) 225 pounds?" Only one out of six participants from the control group had the correct answer, (c) 250 pounds, with five out of eight participants from the intervention group getting the correct answer. This question seems to be the most difficult to correctly answer.

The second question is #14, an ergonomic awareness-based statement. The statement reads, "If I feel weakness in my hands while working, I will talk to my supervisor." Seven, or half, of the participants from both the control and intervention groups were neutral, disagreed, or strongly disagreed with this statement. It is alarming that these workers are not all agreeing that they should report work-related musculoskeletal disorder symptoms to their supervisor. The reasons why the participants answered and felt this way are not known.

Delimitation

Sample size represented sheet metal worker apprentices attending a unionized training center in the greater Sacramento area. The sample size may not be generalizable to the population of sheet metal workers in California or the United States as a whole.

Limitations

1. In an attempt to test more sheet metal workers who were on summer break from their apprenticeship program, the study was set up by mail. However, even though an incentive was offered to those returning the questionnaire, the return rate was a low of only 12%. This limited the statistical power of the study.

2. The introductory letter, consent form, questionnaire, and brochure may have appeared to be somewhat lengthy or intimidating and may have influenced the response, or lack thereof, of the sample population.

3. Reasons of those who did not return the questionnaire are not known. It is not possible to determine if those who did not return the packet did not want to take the time to read the material or complete the questionnaire, did not understand the purpose of the study, or were not interested with the subject matter.

Implications

Even though the findings do not have any statistical power, this study did imply that more experienced sheet metal workers have more awareness and knowledge about ergonomics than newer workers. The sheet metal workers with more experience answered the questions more accurately than the newer sheet metal workers.

Since few sheet metal workers participated in the study, it implies that a stronger design study may yield more conclusive results. For example, if the study involved one-on-one or group discussion prior to taking the questionnaire, then more workers may have participated.

Future Direction

What follow up studies could be done? First, talk about the written ergonomic material with the workers before giving them the questionnaire. This could be done during the sheet metal workers' apprenticeship class.

Secondly, the population receiving the written ergonomic material for this study were students in an apprenticeship program and had to speak and write English to be in the program; however, it is unknown if the participants had any literacy or language barriers with the instructions and questions. Consider offering the questionnaire and brochures in Spanish.

Finally, the ultimate goal of providing written ergonomic educational material is to increase the workers' awareness and knowledge about work-related musculoskeletal disorders to prevent injuries. A follow-up study should be done to see if any of this information leads to behavior practices that prevent injuries. Do the workers who read the information follow the suggestions on working safer to prevent work-related musculoskeletal disorders?

Summary

Given the fact that the most frequent type of injury to sheet metal workers occurs due to overexertion, accounting for 28% of the non-fatal injuries (Schneider, 2001), more needs to be done to prevent these injuries from occurring. Augmenting sheet metal workers' ergonomic awareness and ergonomic knowledge alone does not indicate that work-related musculoskeletal disorders will cease; however, it is a prerequisite and foundation toward the ultimate prevention of work-related musculoskeletal disorders (Dollahite et al., 1996). Overall, it is imperative that employers and employees understand the principles of ergonomics, which includes the causes, symptoms, and prevention of work-related musculoskeletal disorders, in order for this debilitating illness and injury to cease. Sheet metal workers do have some control over how they work, such as tool selection and lifting technique; however, additional attention needs to be on ergonomic education. When sheet metal workers are aware and have knowledge about their work activities that lead to work-related musculo-skeletal disorders, then it inaugurates the first step toward the prevention of these disorders. It is important that additional studies are done to reinforce and ensure that the message on how to prevent musculoskeletal disorder injuries to the sheet metal worker population is done in the most effective way possible.

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APPENDIX A

Subchapter 7. General Industry Safety Orders

Group 15. Occupational Noise
Article 106. Ergonomics

§5110. Repetitive Motion Injuries.

ERGONOMICS -- HISTORY OF CALIFORNIA STANDARD

(a) Scope and application. This section shall apply to a job, process, operation where a repetitive motion injury (RMI) has occurred to more than one employee under the following conditions:

(1) Work related causation. The repetitive motion injuries (RMIs) were predominantly caused (i.e. 50% or more) by a repetitive job, process, or operation;

(2) Relationship between RMIs at the workplace. The employees incurring the RMIs were performing a job process, or operation of identical work activity. Identical work activity means that the employees were performing the same repetitive motion task, such as but not limited to word processing, assembly or, loading;

(3) Medical requirements. The RMIs were musculoskeletal injuries that a licensed physician objectively identified and diagnosed; and

(4) Time requirements. The RMIs were reported by the employees to the employer in the last 12 months but not before July 3, 1997.

(b) Program designed to minimize RMIs. Every employer subject to this section shall establish and implement a program designed to minimize RMIs. The program shall include a worksite evaluation, control of exposures which have caused RMIs and training of employees.

(1) Worksite evaluation. Each job, process, or operation of identical work activity covered by this section or a representative number of such jobs, processes, or operations of identical work activities shall be evaluated for exposures which have caused RMIs.

(2) Control of exposures which have caused RMIs. Any exposures that have caused RMIs shall, in a timely manner, be corrected or if not capable of being corrected have the exposures minimized to the extent feasible. The employer shall consider engineering controls, such as work station redesign, adjustable fixtures or tool redesign, and administrative controls, such as job rotation, work pacing or work breaks.

(3) Training. Employees shall be provided training that includes an explanation of:

(A) The employer's program;

(B) The exposures which have been associated with RMIs;

(C) The symptoms/consequences of injuries caused by repetitive motion;

(D) The importance of reporting symptoms and injuries to the employer; and
(E) Methods used by the employer to minimize RMIs.

(c) Satisfaction of an employer's obligation. Measures implemented by an employer under subsection (b)(1), (b)(2), or (b)(3) shall satisfy the employer's obligations under that respective subsection, unless it is shown that a measure known to but not taken by the employer is substantially certain to cause a greater reduction in such injuries and that this alternative measure would not impose additional unreasonable costs.

APPENDIX B

Subchapter 4. Construction Safety Orders

Article 3. General
§1509. Injury and Illness Prevention Program.

(a) Every employer shall establish, implement and maintain an effective Injury and Illness Prevention Program in accordance with section 3203 of the General Industry Safety Orders.

(b) Every employer shall adopt a written Code of Safe Practices which relates to the employer's operations. The Code shall contain language equivalent to the relevant parts of Plate A-3 of the Appendix.

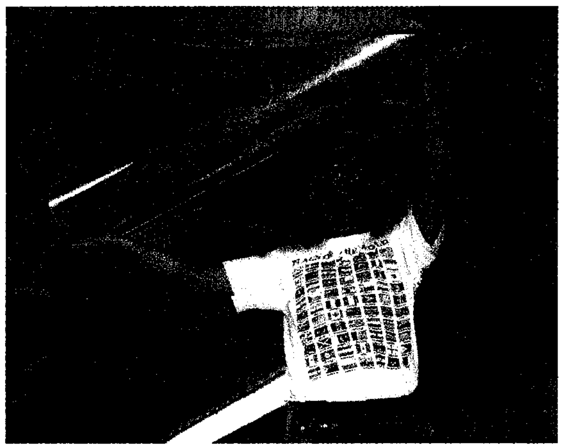
(c) The Code of Safe Practices shall be posted at a conspicuous location at each job site office or be provided to each supervisory employee who shall have it readily available.

(d) Periodic meetings of supervisory employees shall be held under the direction of management for the discussion of safety problems and accidents that have occurred.

(e) Supervisory employees shall conduct "toolbox" or "tailgate" safety meetings, or equivalent, with their crews at least every 10 working days to emphasize safety.

NOTE: Authority cited: Sections 142.3 and 6401.7, Labor Code. Reference: Sections 142.3 and 6401.7, Labor Code.

SURVIVAL GUIDE FOR
SHEET METAL WORKERS



What will happen to your family and your lifestyle if you get injured and can't work? What will you lose if you get injured?

- **Your salary**
- **Your quality of life**
- **Your job advancement**
- **Future job opportunities**

WHAT CAN YOU DO TO AVOID AN INJURY?

This SURVIVAL GUIDE is designed to promote awareness of safe work practices for SHEET METAL WORKERS.

To order this guide and other trade-specific publications, please call 1-800-963-9424 or download a p e

(ht Kristine Lu Whigam Schultz

Appendix C

CONSULTATION CAL OSHA SERVICE

[illegible]an Make You Hurt?

There are certain things in your job that can lead to fatigue, discomfort, or pain when you do them **repeatedly or without breaks**.

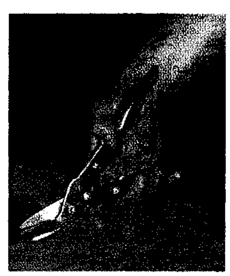
These include:

- Exerting force to perform a task or to use a tool.
- Working in positions such as bending, kneeling, stooping, twisting, and overhead reaching.
- Using awkward hand, wrist, elbow, or shoulder postures.
- Remaining in the same position for a long time with little or no movement.
- Continuous pressure from a hard surface or edge on any part of the body.
- Working in very hot or very cold temperatures produced by climate, equipment, or machines.
- Sitting on, standing on, or holding equipment or tools that vibrate.

In addition, stressful work situations can increase muscle tension and reduce awareness of proper work technique.

Most common injuries:

Back
Wrists and Hands
Knees
Neck and Shoulders



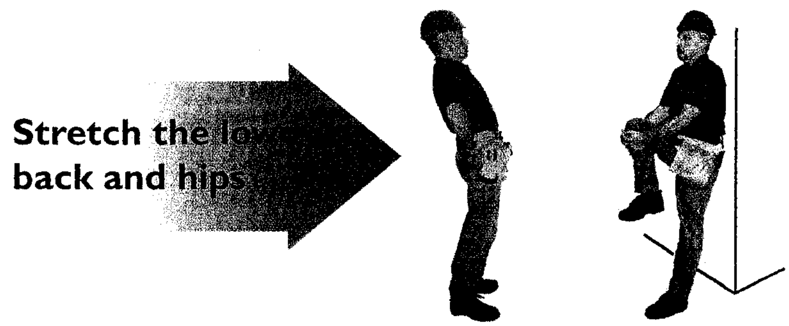
SAFETY TIPS
SAFE WORK PRACTICES
AWARENESS

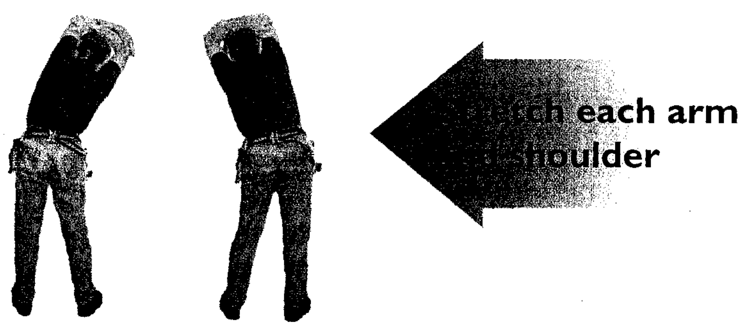
Yourself for Work

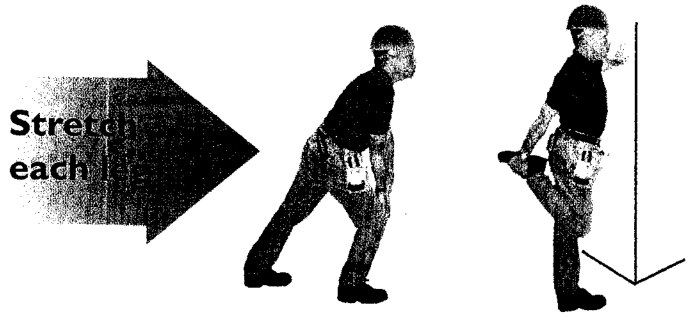
Just as a runner prepares for a race event by warming up, prepare for work by warming up and stretching. Warm up by walking, marching in place, or moving your arms in circles. Once your muscles are warm:

- Stretch S-L-O-W-L-Y and hold each stretch 3-5 seconds.
- Stretch a few minutes before and during your workday.

Caution: *Check with your doctor before exercising. If you feel discomfort while exercising, stop immediately!*







While you are off work, keep yourself physically ready for returning to work, whether it's the next day or later.

Be Aware

If you experience symptoms, you must change the way you work or the tools you use. If you don't change, your symptoms may get worse and may keep you from working at all.

You may have a problem if you have any of these symptoms:

- Constant fatigue
- Cold hands
- Swelling
- Numbness
- Tingling
- Lack of energy
- Changes in skin color
- Weakness
- Loss of sensation
- Aching, burning, or shooting pain

Where?

- Back
- Hands
- Neck
- Fingers
- Shoulders
- Knees
- Arms

If you develop any symptoms:

- Talk with your supervisor about your symptoms right away.
- Work with your supervisor to identify the cause of the problem.
- Follow your company's ergonomics program and its Injury and Illness Prevention Program.
- Always look for better ways to do your job.

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assistance in the r

Jim Albers – NIOS
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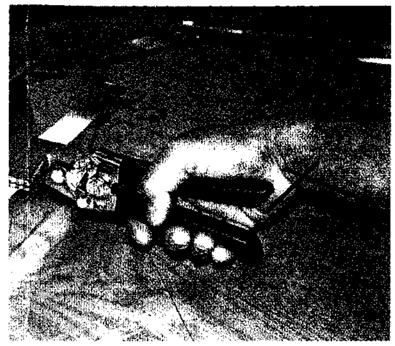
YPICAL WAY

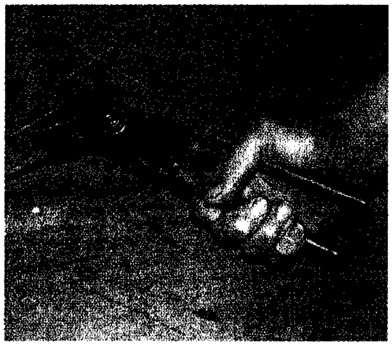
Bending your wrist when using a hand tool may cause hand fatigue. Over time, you could develop numbness or pain in your hand and fingers.



Kneeling while working can cause awkward arm postures and put pressure on your knees. This work posture may cause pain and discomfort.

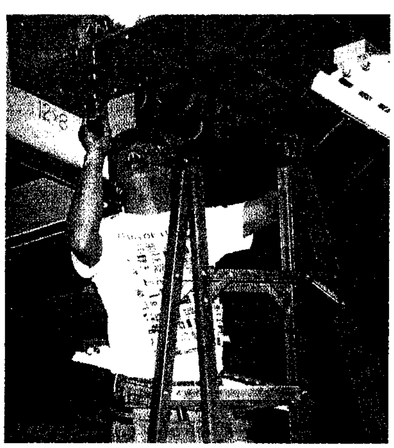
Working overhead and reaching out with a tool for long periods of time may lead to lower back, arm, shoulder, and neck injuries.

A SAFER WAY



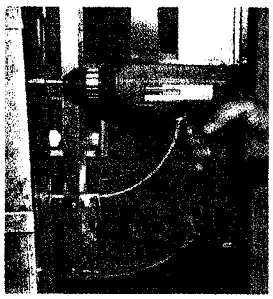
Keep your wrist straight by using an angled tool or repositioning the material. When your wrist is straight, you have better grip strength, and your hand will not fatigue as easily.

- Make your work easier by working in comfortable postures.
- Use existing equipment to create a stable "work bench" that allows you to stand upright while keeping your arms close to your side.
- Keep cutting tools sharp to reduce the force required.
- If you do a lot of cutting, use a power saw.



- Move closer and center yourself to the work area.
- If available, use a scissors lift or other work platform.
- Use lighter-weight tools.
- Wear a hard hat and eye protection.

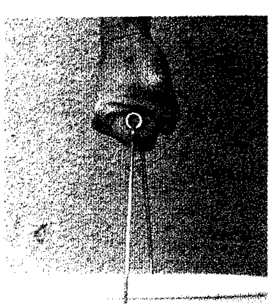
Make It Easy on Yourself



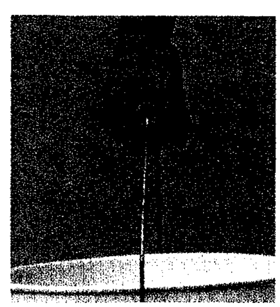
SELECT THE RIGHT TOOL.
Choose tools that fit your hand comfortably. Whenever possible, use power tools or tools that require less force. Let your supervisor know if you need training on a new tool or process.

PRACTICE GOOD HOUSEKEEPING.
Pick up debris and scrap material to prevent slips, trips, and falls. Keep pathways clear for carts, wheelbarrows, and dollies.

CHANGE WORK POSITIONS.
Working overhead or in cramped spaces forces the body into awkward postures. To relieve muscle tension and improve circulation, change body positions, alternate tasks, and stretch throughout the day.



USE A MORE COMFORTABLE HANDLE.
When lifting a bucket, you will use less grip force if you increase the diameter of the handle by adding padding or by using a handle that has a bigger diameter.



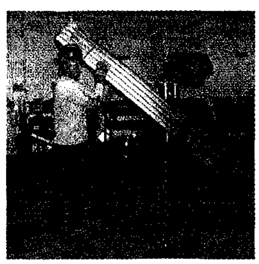
Lifting Tips

- Use teamwork and mechanical aids such as a cart whenever possible.

General lifting tips for heavy and light loads:
- Face the load and keep your waist straight.
- Bring the load close to your body.
- Breathe out and tighten your stomach as you lift.

3-Point Lift:
- Use a 3-point lift when handling heavy material by yourself.

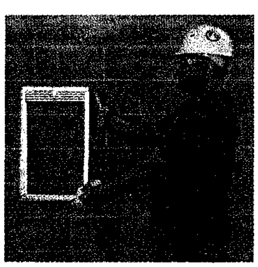
1. Squat



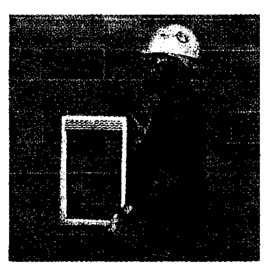
2. Tilt on end

3. Lift

KEEP THE LOAD OR TOOL CLOSE TO YOUR BODY



Lifting, or carrying a **10-pound** object that is **25 inches** from your spine is equal to **250 pounds** of force on your lower back.



Lifting, or carrying a **10-pound** object that is **10 inches** from your spine is equal to **100 pounds** of force on your lower back.

Cal/OSHA CONSULTATION SERVICE
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Attachment 1

Ergonomic Survival Guide for Sheet Metal Workers

A copy of this multi-color, multi-page brochure appears in the pocket.


WHAT YOU
NEED TO KNOW
ABOUT
AIR BAGS
Kristine Lu Whigam Schultz
Appendix D

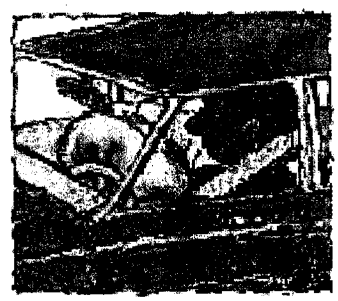
WHAT YOU NEED TO KNOW

ABOUT AIR BAGS

If you are among the millions of Americans who will soon purchase, lease or rent a motor vehicle, it will be equipped with one or more air bags. Air bags are called supplemental restraints because they are designed to work best in combination with safety belts. You should always wear your safety belt whether or not your car has an air bag. All new passenger cars, light trucks and vans are equipped with both driver and passenger front air bags. (While many new vehicles are being equipped with side air bags, this brochure focuses mainly on front air bags. See the "New Technology" section for information on new air bag technologies.)

The Air Bag System for Frontal Crashes

The air bag system consists of three basic parts — an air bag module, crash sensors and a diagnostic unit. Some systems may also have an on/off switch, which allows the air bag to be deactivated.



1 The **AIR BAG MODULE** contains both an inflator unit and the lightweight fabric air bag. The driver air bag module is located in the steering wheel hub, and the passenger air bag module is located in the instrument panel. When fully inflated, the driver air bag is approximately the diameter of a large beach ball. The passenger air bag can be two to three times larger since the distance between the right-front passenger and the instrument panel is much greater than the distance between the driver and the steering wheel.

continued next page

2 The **CRASH SENSORS** are located either in the front of the vehicle and/or in the passenger compartment. Vehicles can have one or more crash sensors. The sensors are typically activated by forces generated in significant frontal or near-frontal crashes. Sensors measure deceleration, which is the rate at which the vehicle slows down. Because of this, the vehicle speed at which the sensors activate the air bag varies with the nature of the crash. Air bags are not designed to activate during sudden braking or while driving on rough or uneven pavement. In fact, the maximum deceleration generated in the severest braking is only a small fraction of that necessary to activate the air bag system.

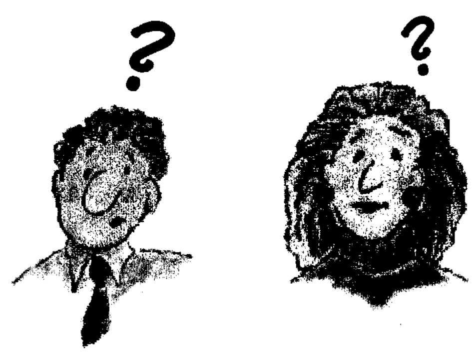
3 The **DIAGNOSTIC UNIT** monitors the readiness of the air bag system. The unit is activated when the vehicle's ignition is turned on. If the unit identifies a problem, a warning light alerts the driver to take the vehicle to an authorized service department for examination of the air bag system. Most diagnostic units contain a device, which stores enough electrical energy to deploy the air bag if the vehicle's battery is destroyed very early in a crash sequence.

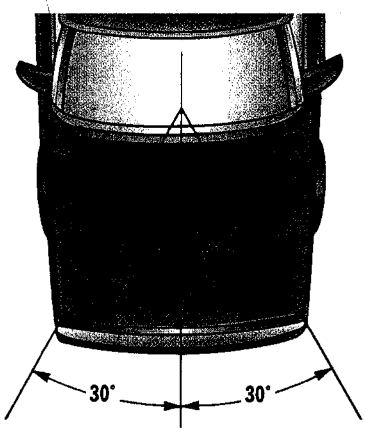
4 Some vehicles without rear seats, such as pick up trucks and convertibles, or with rear seats too small to accommodate rear-facing child restraints, have manual ON/OFF switches for the passenger air bag installed at the factory. ON/OFF switches for driver or passenger air bags may also be installed by qualified service personnel at the request of owners who meet government-specified criteria and who receive government permission. (For more details, see the section "Deactivation.")

When Do Air Bags Deploy?

Air bags are typically designed to deploy in frontal and near-frontal collisions, which are comparable to hitting a solid barrier at approximately 8 to 14 miles per hour (mph). Roughly speaking, a 14 mph barrier collision is equivalent to striking a parked car of similar size across the full front of each vehicle at about 28 mph. This is because the parked car absorbs some of the energy of the crash, and is pushed by the striking vehicle. Unlike crash tests into barriers, real-world crashes typically occur at angles, and the crash forces usually are not evenly distributed across the front of the vehicle. Consequently, the relative speed between a striking and struck vehicle required to deploy the air bag in a real-world crash can be much higher than an equivalent barrier crash.

Because air bag sensors measure deceleration, vehicle speed and damage are not good indicators of whether or not an air bag should have deployed. Occasionally, air bags can deploy due to the vehicle's undercarriage violently striking a low object protruding above the roadway surface. Despite the lack of visible front-end damage, high deceleration forces may occur in this type of crash, resulting in the deployment of the air bag.





Angle of Frontal Impact

Most air bags are designed to automatically deploy in the event of a vehicle fire when temperatures reach 300 to 400 degrees Fahrenheit. This safety feature helps to ensure that such temperatures do not cause an explosion of the inflator unit within the air bag module.

Front air bags are not designed to deploy in side impact, rear impact or rollover crashes. Since air bags deploy only once and deflate quickly after the initial impact, they will not be beneficial during a subsequent collision. Safety belts help reduce the risk of injury in many types of crashes. They help to properly position occupants to maximize the air bag's benefits and they help restrain occupants during the initial and any following collisions. So, it is extremely important that safety belts always be worn, even in air bag-equipped vehicles.

When a Collision Occurs

When a crash occurs, the vehicle rapidly decelerates while its structure absorbs the majority of the crash forces. Unbelted occupants continue to move forward at the vehicle's original speed until the vehicle's interior (the steering wheel, instrument panel, windshield, etc.) stops their movement. Belted occupants come to a more gradual stop by being secured to the vehicle's structure. In severe crashes, even properly belted occupants may come into contact with the vehicle's interior.

Air bags supplement the safety belt by reducing the chance that the occupant's head and upper body will strike some part of the vehicle's interior. They also help reduce the risk of serious injury by distributing crash forces more evenly across the occupant's body.

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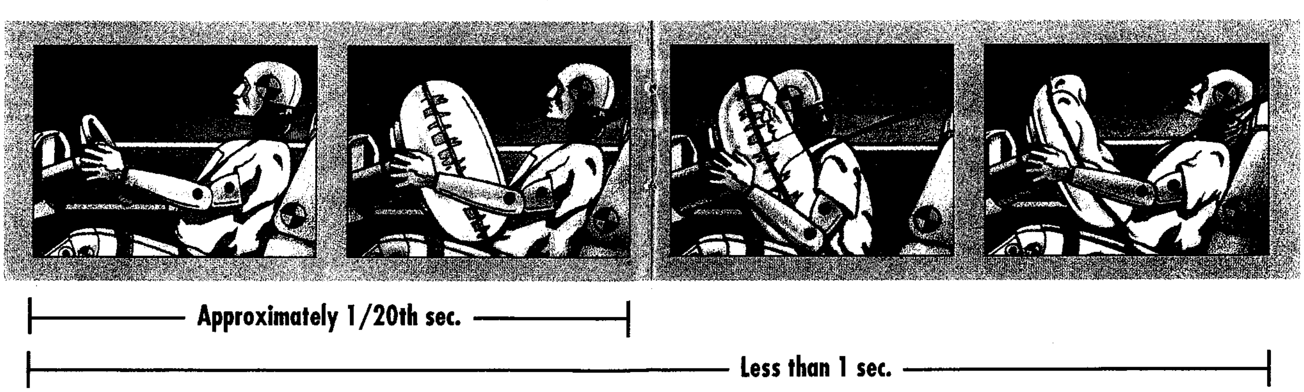

When a Collision Occurs (cont.)

When there is a moderate to severe frontal crash that requires the frontal air bag to deploy, a signal is sent to the inflator unit within the air bag module. An igniter starts a reaction, which produces a gas to fill the air bag, making the air bag deploy through the module cover. Some air bag technologies use nitrogen gas to fill the air bag while others may use argon gas. The gases used to fill air bags are harmless.

From the onset of the crash, the entire deployment and inflation process takes only about 1/20th of a second, faster than the blink of an eye. Because a vehicle changes speed so fast in a crash, air bags must inflate rapidly if they are to help reduce the risk of the occupant hitting the vehicle's interior.

What Happens After a Deployment?

Once an air bag deploys, deflation begins immediately as the gas escapes through vents in the fabric. Deployment is frequently accompanied by the release of dust-like particles in the vehicle's interior. Most of this dust consists of cornstarch or talcum powder, which are used to lubricate the air bag during deployment. Small amounts of sodium hydroxide may initially be present. This chemical can cause minor irritation to the eyes and/or open wounds; however, with exposure to air, it quickly turns into sodium bicarbonate (common baking soda). Depending on the type of air bag system, potassium chloride (a table salt substitute) may also be present.

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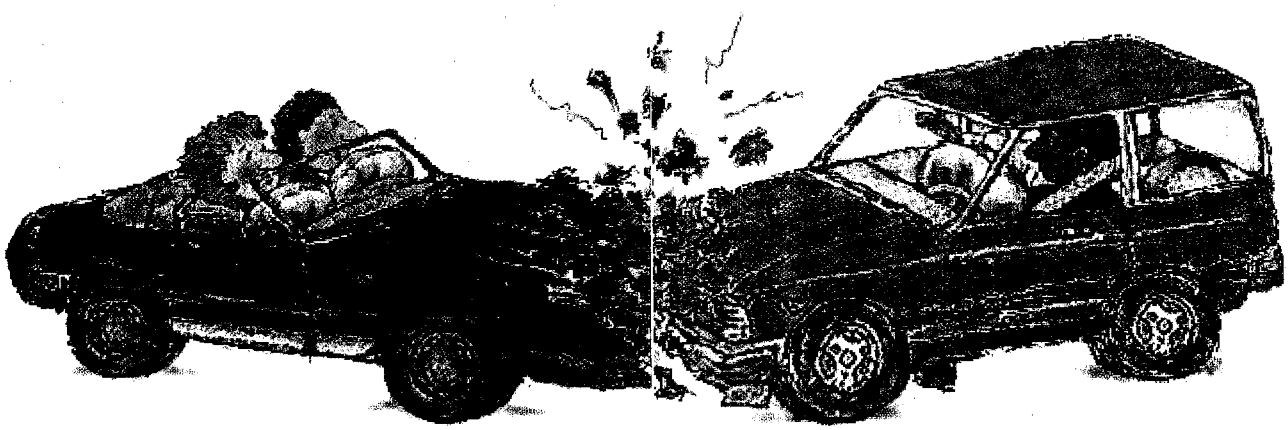
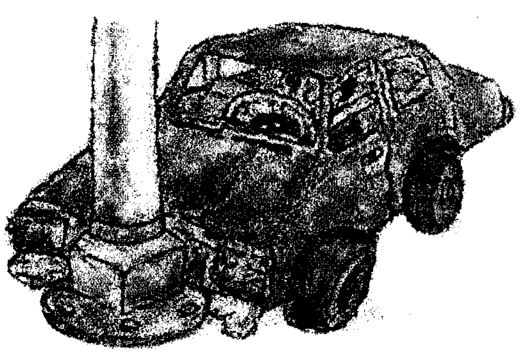


What Happens After a Deployment? (cont.)

For most people, the only effect the dust may produce is some minor irritation of the throat and eyes. Generally, minor irritations only occur when the occupant remains in the vehicle for many minutes with the windows closed and no ventilation. However, some people with asthma may develop an asthmatic attack from inhaling the dust. With the onset of symptoms, asthmatics should treat themselves as advised by their doctor, then immediately seek medical treatment.

Once deployed, the air bag cannot be reused and should be replaced by an authorized service department. Because the air bags only deploy once, do not drive the vehicle until the air bags have been replaced.



Air Bag Contact Injuries

Air bags must inflate very rapidly to be effective, and therefore come out of the steering wheel hub or instrument panel with considerable force, generally at a speed over 100 mph. Because of this initial force, contact with a deploying air bag may cause injury. These air bag contact injuries, when they occur, are typically very minor abrasions or burns.

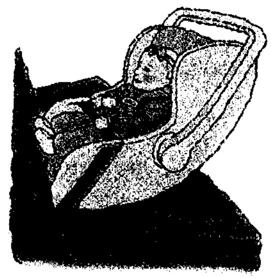
More serious injuries are rare; however, serious or even fatal injuries can occur when someone is very close to, or in direct contact with an air bag module when the air bag deploys. Such injuries may be sustained by unconscious drivers who are slumped over the steering wheel, unrestrained or improperly restrained occupants who slide forward in the seat during pre-crash braking, and even properly restrained drivers who sit very close to the steering wheel. Never attach objects to an air bag module or place loose objects on or near an air bag module, since they can be propelled with great force by a deploying air bag, potentially causing serious injuries.

An unrestrained or improperly restrained occupant can be seriously injured or killed by a deploying air bag. The National Highway Traffic Safety Administration (NHTSA) recommends drivers sit with at least 10 inches between the center of their breastbone and the center of the steering wheel. Children 12 and under should always ride properly restrained in a rear seat. Never put a rear-facing infant restraint in the front seat of a vehicle with a front passenger air bag. A rear-facing infant restraint places an infant's head close to the air bag module, which can cause severe head injuries or death if the air bag deploys. (See the next section, "Air Bags, Safety Belts and Child Safety Seats.")

Air Bags, Safety Belts and Child Safety Seats

All front seat occupants must be correctly positioned in order to optimize the benefits of a deploying air bag. The proper use of safety belts is an important part of correct positioning. Unbelted or improperly belted occupants can come into contact with the air bag module during pre-crash braking. Being near or against an air bag module when it deploys can result in serious or fatal injury.

Safety belts should always be worn with the lap belt low and snug across the hips and the shoulder belt across the chest. Shoulder belts should never be placed under the arm or behind the back. Front seat drivers and passengers should sit upright against the back of the seat. Passengers should adjust the seat as rearward as practical. Drivers should adjust the seat such that they position themselves away from the air bag module, while maintaining the ability to safely operate all vehicle controls. Moving the seat rearward, slightly reclining the seat back and/or tilting the adjustable steering wheel downward can change the driving position. Remember, NHTSA recommends there must be at least 10 inches distance between the steering wheel hub, where the air bag module is located, and the driver's breastbone.



Children are safest when properly restrained in a rear seat, whether the vehicle has an air bag or not. Infants should be restrained in rear-facing restraints until they reach 20 pounds and are at least one year of age. Never put a rear-facing infant restraint in the front seat of a vehicle with a front passenger air bag. The back of the rear-facing infant restraint rests too close to the air bag module, creating the potential for serious or fatal injuries from a deploying air bag.

After children reach 20 pounds and one year of age, they can be moved into forward-facing child restraints. When children exceed 40 pounds in weight, they should ride in belt-positioning booster seats until the vehicle safety belt fits properly (see page 12), which as a rule of thumb may be until they are at least 8 years old, unless they are 4'9" tall. Most booster seats accommodate children up to 80 lbs. Always follow the child restraint and vehicle manufacturers' instructions for proper use and installation of child restraints.

Pregnant women should always wear their safety belts. They should sit as far back as possible from the air bag with the lap portion of the belt correctly positioned over the hips (not the stomach) and the shoulder portion across the chest.

Deactivation

The vast majority of people can benefit greatly from an air bag, and can reduce any risk of air bag contact injuries just by buckling up on every trip and properly restraining children 12 and under in a rear seat. Almost all air bag-related deaths have involved unrestrained or improperly restrained occupants. Since the combination of an air bag and a safety belt reduces the risk of serious head injury by 83 percent, consumers are urged to carefully consider their needs prior to installing an on/off switch.

However, NHTSA will allow some consumers to install an on/off switch to disconnect a driver or passenger air bag, but only if they fall into one of the following categories:

- Those who have a medical condition that places them at specific risk.
- Those who cannot adjust their driver's position to keep at least 10 inches from the steering wheel.
- Those who cannot avoid situations that require a child 12 or under to ride in the front seat.

Automakers are not required to make the switches available, nor are dealers required to install them. Due to vehicle design and other considerations, switches may not be available for all vehicle makes and models.

Even those who may be eligible for the on/off switch may be able to safely accommodate the air bag by going through the following steps:

- Discuss your medical condition with your physician and together decide whether an air bag switch is appropriate for you.
- To get more space between you and the steering wheel, move the seat farther back or adjust the angle of the seatback. If you are shopping for a new car, sit in several models or consider a power seat option to enable you to sit comfortably farther away from the steering wheel.
- Children are safer in a rear seating position, with or without an air bag. In more than 70% of the cases where a child in the front seat was killed in a crash, there was a vacant rear seating position available. If you are looking for a new car, select one with enough rear seating positions to accommodate the maximum number of children you expect to transport.

If you still think you need an on/off switch, contact your vehicle manufacturer to find out if a switch is available for your vehicle. You will then need to obtain permission to install the switch from NHTSA by obtaining a request form (1-888-327-4236 or www.nhtsa.dot.gov).

New Technologies

Advanced Air Bag Technologies

Many advanced air bag technologies are being developed to tailor air bag deployment to the severity of the crash, the size and posture of the vehicle occupant, belt usage and how close that person is to the air bag module. Many of these systems will use multi-stage inflators that deploy less forcefully in stages in moderate crashes than in very severe crashes. Occupant sensing devices let the air bag diagnostic unit know if someone is occupying a seat in front of an air bag, whether the person is an adult or a child, whether a seat belt or child restraint is being used and whether the person is forward in the seat and close to the air bag module. Based on this information and crash severity information, the air bag is deployed at either a high force level, a less forceful level or not at all.

For evaluating advanced air bag systems, laboratory tests utilizing a family of crash test dummies will be required. In addition to tests using a dummy representing an average adult male, future air bag systems will be tested with a small adult female dummy and dummies representing one, three and six year old children. These new NHTSA requirements are being phased in over the next several years with some vehicles already in production.

However, even with advanced air bag technologies, children ages 12 and under should always ride in a rear seating position in an appropriate restraint system.

Side and Rollover Air Bags

Many new vehicles are also equipped with side air bags. While there are several types of side air bags, all are designed to reduce the risk of injury in moderate to severe side impact crashes. These air bags are generally located in the outboard edge of the seat back, in the door or in the roof rail above the door.

Seat and door-mounted air bags all provide upper body protection. Some also extend upwards to provide head protection. Two types of side air bags, known as inflatable tubular structures and inflatable curtains, are specifically designed to reduce the risk of head injury and/or help keep the head and upper body inside the vehicle. A few vehicles are now being equipped with a different type of inflatable curtain designed to help reduce injury and ejection from the vehicle in rollover crashes. Read your owner's manual for specific information about the air bags in your vehicle.

Unlike front air bags, side air bags are neither required nor regulated by NHTSA. At NHTSA's request, a Technical Working Group representing automakers, air bag suppliers and independent safety organizations has developed comprehensive uniform test procedures for side air bags. The test procedures will help air bag designers to evaluate the risk of inflation-related

continued next page

New Technologies (cont.)

injuries to out-of-position occupants, particularly children and small adults, and to design systems that minimize these risks. All vehicle manufacturers have agreed to utilize these tests when designing future side air bag systems.

While side air bags are smaller than front air bags, they must deploy very rapidly. Close proximity of a child's head, neck or chest to a side air bag may cause serious injury. Therefore, it is important never to lean up against or rest against a side air bag. Seat belts (or child restraints as appropriate) should always be worn to avoid possible injury by keeping enough distance between the occupant and the side air bag module.

If you transport children and are thinking about buying a car with side air bags in rear seating positions, check the vehicle and child restraint manufacturers' recommendations for child restraint use in that vehicle.

Summary

Always Wear Your Safety Belt.

Restrain All Children in a Rear Seat.

Air bags, while they save lives, are but one of many important vehicle safety systems. It is critical that occupants always properly wear their safety belts and remember:

- Never put a rear-facing infant restraint in the front seat of a vehicle with a front passenger air bag.
- Children 12 and under should be properly restrained in a rear seat.
- Drivers should sit with at least 10 inches between the center of their breastbone and the center of the steering wheel.
- Front air bags are designed to deploy only in moderate to severe frontal or near-frontal collisions, and do not reduce the risk of injury in rear, side or rollover crashes. Safety belts help reduce injury risk in many types of crashes.
- Air bags deploy only once. Safety belts help restrain occupants during the initial and any following collisions, if the vehicle strikes more than one object.
- Safety belts help keep front seat occupants in position to maximize an air bag's effectiveness. Remember, very close or direct contact with an air bag module during deployment can cause serious or even fatal injury.

ACTS

Automotive Coalition
for Traffic Safety, Inc.

1601 North Kent Street, Suite 1103
Arlington, VA 22201
(703) 243-7501
www.actsinc.org

Distributed in cooperation with the National Highway Traffic Safety Administration.

NHTSA

People Saving People
www.nhtsa.dot.gov

1-888-DASH-2-DOT

DOT HS 809 575
November 2002

Attachment 2

What You Need to Know About Air Bags

A copy of this multi-color, multi-page brochure appears in the pocket.

APPENDIX C

Questionnaire

Please read the brochure, then answer these questions. Make sure to mark all questions so that your answers can be used. If you do not know the answer, please take your best guess. **Do not look at the brochure while answering the questions.**

Gender (circle one): M F **Years of Experience in Sheet Metal Work:** ______
Age: ________ **Year in Apprenticeship Program:** 1 2 3 4 5
Highest grade of school completed: 7 8 9 10 11 12 13 14 15 16 17+

Select **one best** answer to each of the following questions based on the brochure

---

1. What can you lose if you get injured at work and can't work?
   (a) Your salary
   (b) Your cell phone
   (c) Your tools
   (d) Your friends

2. The most common injuries in sheet metal work affect specific body part(s), such as:
   (a) Toes
   (b) Back
   (c) Elbows
   (d) Hips

3. Certain things in your job can lead to fatigue, discomfort, or pain if you do them repeatedly or without breaks. These include (select one best answer):
   (a) Using a forklift to move material.
   (b) Remaining in the same position for a long time with little or no movement.
   (c) Exerting pressure on your stomach to perform a task.
   (d) Writing out a work order.

4. What are some ways you can physically prepare for work?
   (a) Listen to the morning news
   (b) Put your seatbelt on while driving or riding in a vehicle
   (c) Warm up and stretch
   (d) Take a hot shower

5. If you have to lift a long, heavy piece of material from the floor by yourself, it is helpful to:
   (a) squat; tilt object on end; lift
   (b) bend forward; breathe in; lift
   (c) bend forward; grasp the object; lift
   (d) squat; grasp tight; lift

6. A 10-pound object that is 25 inches from your spine is equal to what weight of force on your lower back:
   (a) 50 pounds
   (b) 175 pounds
   (c) 250 pounds
   (d) 225 pounds

7. If you experience symptoms of injury, you must change the way you work or the tool you use. What are some of the symptoms?
   (a) Damp hands, perspiration
   (b) Headache, blurry vision
   (c) Numbness, tingling
   (d) Stomachache, nausea

8. What can help you make your work easier and avoid injury?
(a) Changing body positions; alternating work tasks as much as possible
(b) Going home from work early
(c) Eating breakfast
(d) Changing employers

9. Keeping your wrist straight by using an angled tool or repositioning the material will:
(a) protect your hands
(b) cause pain over time
(c) give you better grip strength
(d) make it difficult to do your work

10. To avoid kneeling while cutting material:
(a) Move your work closer to your body
(b) Use existing equipment to create a stable "work bench"
(c) Keep your waist straight
(d) Bend forward

Read each statement and check the box that <u>best</u> describes how much you agree with the statement.

	Strongly Disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
11. I will bend forward at the waist to lift material at work.					
12. Wherever possible I will use power tools or tools that require less force at work.					
13. Muscle strain injuries are <u>not</u> very common in my line of work.					
14. If I feel weakness in my hands while working, I will talk to my supervisor.					
15. There are many things that I could do at work to prevent a muscle strain injury.					

Thank you for answering the questions!!

Please return the SURVEY and RAFFLE TICKET
In the enclosed stamped envelope or drop it off with your OJT Form
At the Sheet Metal Workers Apprenticeship & Training School

DUE NO LATER THAN FRIDAY, SEPTEMBER 5, 2003

APPENDIX D

Letter to Request Permission

SACRAMENTO VALLEY SHEET METAL JOINT
APPRENTICESHIP AND TRAINING FUND COMMITTEES

LARRY W. SINOR
ADMINISTRATOR

July 23, 2003

To Whom it May Concern:

Kristy Schultz, a graduate student in human factors/ergonomics from San Jose State University, contacted me and requested our assistance with her thesis study. We have 130 apprentice students enrolled in our Sheet Metal Apprentice Program. Kristy is interested in mailing them a brochure and survey, and offers them an opportunity to enter a raffle as part of her study.

We have agreed to participate with the mailing surveys to our students and assisting her with her study.

Sincerely,

Larry Sinor

Larry W. Sinor
Administrator

1624 SILICA AVENUE • SACRAMENTO, CALIFORNIA 95815-3429 •
TELEPHONE (916) 922-9381 • FACSIMILE (916) 922-3574

www.sheetmetaltraining.com

San José State
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Department of Industrial & Systems Engineering
Room 283, Engineering Building
One Washington Square
San José, CA 95192-0085
Voice: 408-924-3301
Fax: 408-924-4040
E-mail: isengr@email.sjsu.edu
http://www.engr.sjsu.edu/ise

APPENDIX E

Letter of Instruction and Consent to Participate

August 2003

Dear Sheet Metal Apprentice,

My name is Kristy Schultz and I am a graduate student studying human factors and ergonomics at San Jose State University. The Sheet Metal Apprenticeship & Training Program is assisting me with this research study and I am writing to kindly ask for your participation. The study aims to evaluate what sheet metal workers learn from written safety material.

There is a 1-105 chance of winning a raffle prize of a $50 gift certificate to Home Depot. You do not need to complete the survey to enter the raffle; however, you do need to return the completed raffle entry form. A volunteer not involved with this study will open the returned envelopes and separate the raffle entries from the surveys to ensure that your participation is kept confidential.

Please respond by either mailing the survey and raffle ticket in the enclosed stamped envelope or dropping it off with your OJT Form at the Sheet Metal Workers Apprenticeship & Training School.

Due no later than September 5, 2003

Attached to this letter is information about your rights when being asked to participate in a study. If you have any questions, please feel free to contact me.

Your participation is greatly appreciated.

Sincerely,

Kristy Schultz, CAE
Associate Ergonomic Specialist
2211 Park Towne Circle, Ste. 4
Sacramento, CA 95825
916-574-2514

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E-mail: isengr@email.sjsu.edu
http://www.engr.sjsu.edu/ise

Attachment:

Information Regarding Informed Consent to Participate In a Study

- The responsible person for this study is Kristy Schultz, San Jose State University Graduate Student.
- Title: Evaluating the Effectiveness of Written Material Among Sheet Metal Workers
- The purpose of this study is to evaluate the effectiveness of a brochure to determine if it aids sheet metal workers in increasing their awareness and knowledge on the causes, symptoms, and prevention of injuries and illnesses.
- You are being asked to read the enclosed brochure and compete a 2-page survey.
- No risks are anticipated with your participation in this study.
- The benefit to you for participating is that you will learn about the subject matter and have an opportunity to participate in a raffle contest.
- Although the results of this study may be published, no information that could identify you will be included.
- Questions about this research will be addressed to Kristy Schultz, (916) 574-2514; Questions about research subjects' rights, or research related-injury may be presented to Nabil Ibrahim, Ph.D., Associate Vice President, Graduate Studies and Research, at (408) 924-2480.
- No service of any kind, to which you are otherwise entitled, will be lost or jeopardized if you choose to "not participate" in the study.
- Your consent is being given voluntarily. You may refuse to participate in the entire study or in any part of the study. If you decide to participate in the study, you are free to withdraw at any time without any negative effect on your relations with San Jose State University.
- This attachment and enclosed letter is your copy of consent.